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STAVE RIVER SMOLT IMPRINTING PROJECT - YEAR 2: 2009 PROJECT FINAL REPORT



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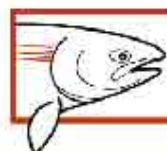
"BC Hydro Bridge Coastal Fish and Wildlife Restoration Program"

BCRP Project # 09.SFN.01

BCCF Report # 01-2009-BCRP



**British Columbia
Conservation
Foundation**



GREATER GEORGIA BASIN
STEELHEAD Recovery Plan
www.SteelheadRecoveryPlan.ca

Executive Summary

The Stave River is a large tributary of the Fraser River with a watershed that encompasses an approximate area of 1,140 km². Hydroelectric generation has occurred within the watershed for approximately 90 years. The creations of these large hydroelectric dams have subsequently reduced the anadromous length of the Stave River from 8 km to less than 2 km. Ultimately, all of the original Stave River salmonid populations suffered, but the greatest decrease in numbers has been demonstrated by the steelhead trout (*Oncorhynchus mykiss*). With the native steelhead stocks in the Stave River decimated, the decision was made to turn the remaining anadromous length of the river into a purely hatchery raised (augmented) system. Steelhead progeny from the Chilliwack River were used to recreate a sport fishery on the Stave with hopes that some pressure would be taken off of the Chilliwack and Chehalis rivers. However, low adult returns have plagued the river since steelhead stocking began. The most reasonable hypothesis has revolved around the idea that the steelhead juveniles are not properly imprinting during their short stay in the Stave River after their release. To combat this problem and test this hypothesis, BC Hydro's Bridge Coastal Restoration Program in partnership with the BC Conservation Foundation, Freshwater Fisheries Society of BC, Kwantlen First Nation, and the BC Ministry of Environment have partnered together to implement the Stave River Steelhead Smolt Imprinting Project. In this second consecutive year of this project, the net pens were used to raise juvenile steelhead in Hayward Lake prior to smolting. After 53 days imprinting, the steelhead averaged 100 grams and were transported and released below Ruskin Dam and all components of the net were removed from the lake. A small portion of adult steelhead from the 2007 brood year (Year 1 Project) were expected to start returning to spawn in the spring of 2010. A snorkel survey was unsuccessful in identifying adult steelhead with adipose and right maxillary clips, however; anglers reported catching and releasing 2 of these fish.

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1. Introduction

Steelhead smolts have been annually released into the lower Stave River since 1986, with mixed results. The Stave River is currently ranked fifth in the region as a destination for steelhead anglers with approximately 1,200 angler days in 2003-04. Despite the annual stocking of approximately 20,000 steelhead smolts annually, success is poor at 0.086 hatchery fish per angler day (2003-04 Steelhead Harvest Analysis, MoE data on file).

Juvenile steelhead are currently held at the Fraser Valley Trout Hatchery (FVTH) and Allco Park Fish Hatchery (ARCC), and not raised on Stave River water until released into the Stave as smolts. The river is less than 3 km in length which limits rearing area and imprinting time, which is theorized to be a contributing factor in the low return rates. The goal of this project is to re-install the net pen purchased in 2008/2009 followed by the stocking, feeding and monitoring of the hatchery-reared steelhead in Hayward Lake to improve imprinting, return rate and angling success. The steelhead smolts will be placed in the net pens Hayward Lake, after initial rearing at FVTH and ARCC, for up to 60 day (March –May) to acclimatize to the Stave River/Hayward Lake water before being transported and released into the lower Stave River.

The funds received by BC Hydro – Bridge Coastal Fish and Wildlife Restoration Program (BCRP) were used in the set-up and initiation of the net pen project and in the continuation (this year) of the project. Partnership support by way of in-kind labour was received by the Freshwater Fisheries Society of BC (FFSBC) was used in the monitoring, placement, and removal of the net pen and fish, the BC Ministry of Environment for technical support and volunteer support to feed the fish two times a day. The steelhead smolts held in the net pen were differentially marked, adipose and left maxillary (adipose and right maxillary in the previous year), to enable evaluation of returns compared to a control group of smolts not held in the pens and stocked by current methods (i.e. direct release to the lower river from hatchery holdings).

With relationships forged between project partners in the initial project year 2007/2008, consultation with stakeholders for year two was easily accomplished and all stages of the project were completed.

2. Goals and Objectives

2.1 Project Objectives

Footprint issue/limiting factors– There are a number of limiting factors in the Stave River system that effect fish diversity and production. The obvious one is the blocked access to historic habitats. Anadromous and migratory resident populations of fish have been blocked out of river habitat occupied by Hayward Lake for nearly 76 years. Over 2 km of habitat such as spawning beds, rearing, and over wintering areas have been lost or reduced due to the dam locality and operations. Reductions in flow due to water diversion, reservoir flooding, and operating flows have also increased the footprint. The amount and types of habitat below the dam have been reduced; there is a noticeable lack of sediment recruitment and large woody debris collection downstream of the dam. There is a reduction in the tributary access for spawning and migrating fish, mainly due to the drawdown regimes of the reservoirs. In addition, the Stave River is highly populated with coarse fish that compete against the salmonid species.

Value added benefits –Allowing the set-up and initiation of this project will increase angling and recreational opportunities for the public and at the same time aid in the rehabilitation of winter run steelhead on the Stave River. The results gathered through this research will inform fisheries managers top the future direction of hatchery operations on the lower Stave River.

3. Study Area

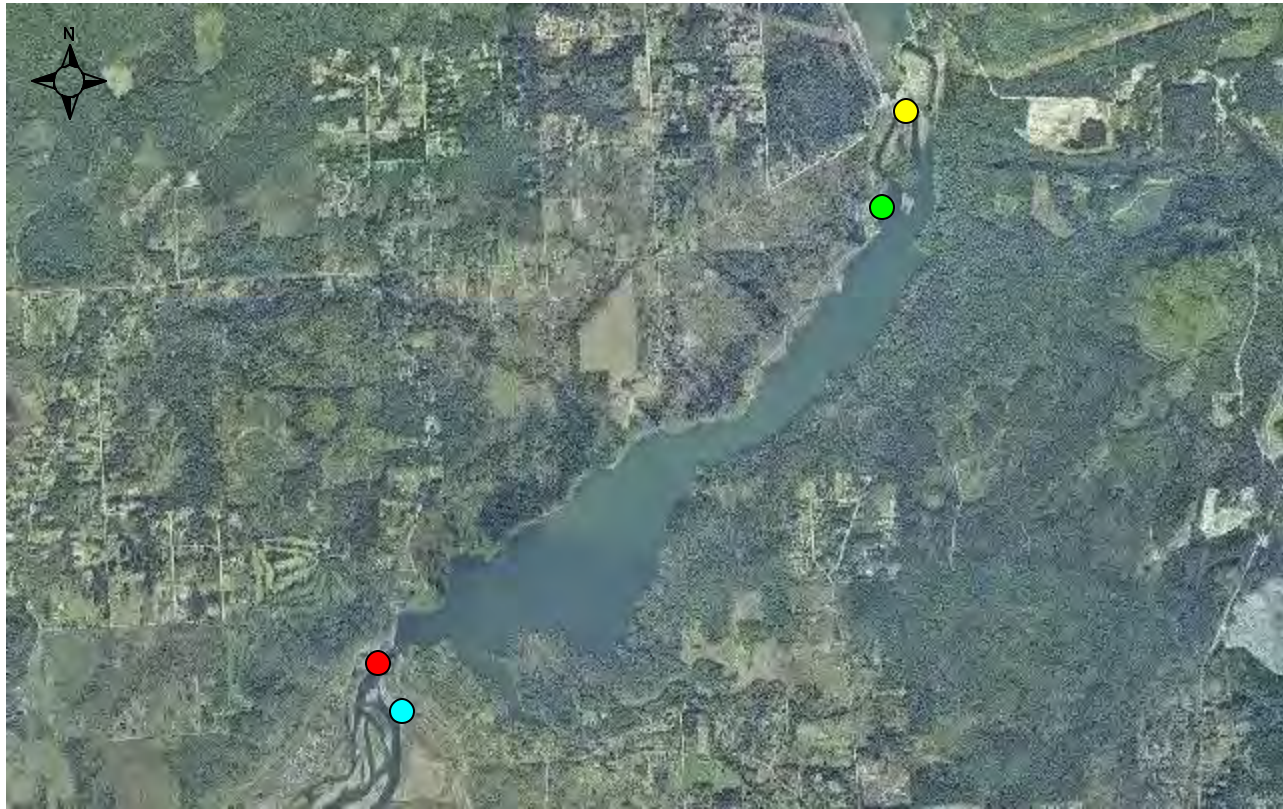
3.1 Habitat attributes and/or biophysical description

The Stave River is a 5th order stream which drains an area of 1,140 km² of the Coastal Mountain range in southwestern BC (Lill 2002), and one of the larger tributaries in the lower Fraser watershed. The Stave Falls and Ruskin hydroelectric dams have regulated its flow since 1911. The Stave River historically supported winter steelhead and presently supports several other species of anadromous salmonids.

3.2 The specific location of the project site

The project is located on Hayward Lake, which is located 15 km east of Maple Ridge, and is part of the Alouette-Ruskin-Stave BC hydro generating system. The project specifically deals with fishery issues in the short anadromous reach of the Stave River downstream of Hayward Reservoir. The BC Hydro Power Authority through the Stave Falls and Ruskin Dams regulates river flow. The Stave River, downstream of the Hayward reservoir, extends 2.8 km to its confluence with the Fraser River. Historically, only the lower 8.8 km of this river were accessible to anadromous salmon due to a number of natural barriers (BC Hydro 2000). The construction of Ruskin Dam and the Hayward Reservoir resulted in the loss of several kilometres plus of usable spawning and juvenile rearing habitat.

Specifically, the net pen was moored on the northwest shore of Hayward Lake (Figure 1). Between on site consultation meetings and phone conversations between BC Hydro, Ministry of Environment (MoE), and BC Conservation Foundation (BCCF) staff this location behind a secure gate was chosen. An existing fenced and gated boat house moored at Hayward Lake recreational park was the perfect location to place the net pen and fish. The site allowed for easy access for installation of the net pen, placement, feeding, and removal of the fish, and removal of the net pen. Also, with BC Hydro staff stationed at the location all day and the park closing every night the chances of vandalism to the net pen were minimized.



Legend

- Stave Falls Dam
- Ruskin Dam
- Net Pen Location
- Release Location

Figure 1: Overview map highlighting specific locations and local landmarks used during the net pen project.

4. Methods

4.1 Project Rationale

The historic steelhead stock primarily used in the enhancement of the Stave River in the past has come from smolts raised in the Chilliwack River and Inch Creek federal hatcheries. Since these juveniles are reared in hatcheries that utilize localized river water as their primary rearing medium and the fishes are released in a different water source, it is theorized that their homing ability may be compromised and has resulted in the low adult return rates to date. To combat this problem, the use of localized juvenile steelhead produced from brood collected from the Stave River was hatched and reared to near smolt size (50-70 grams) at the FVTH and ARCC. The main difference between FVTH and the hatcheries historically used to rear Stave River steelhead is the water source. FVTH is a ground water based rearing facility that stocks trout in lake and river system all across Region 2 and 3, meaning the fish raised in this facility aren't imprinted to a specific water source. The placement of these fish in the Hayward Lake net pen will hypothetically imprint to Stave River water and will have increased homing ability and we are expecting adult returns to increase. Net pen reared fish this year have an adipose clip and a left maxillary clip. Conversely, fish released directly to the lower Stave through hatchery releases will only have an adipose clip. In the previous years' project (2008/09), net pen reared fish received an adipose clip and a left maxillary clip. The purposed of this additional differential clip is to accurately differentiate between returning hatchery adults from the net pen compared to smolts from the existing annual stocking program, in addition to being able to differentiate between fish stocked in 2008/09 (right max. clip) and 2009/10 (left max. clip).

4.2 Net Pen Placement

The net pen is constructed from plastic moulded sections which are secured to one another using held together with large rubber grommets. This design creates a very stable platform and one capable of withstanding considerable weight and the elements. In addition, the sections are lightweight and can be easily disassembled and stacked during storage. The overall dimensions of the net are 20 feet by 20 feet, therefore, a net measuring 20 wide by 20 long by 20 feet deep is used to house the fish. To mitigate against losses to predation, the net pen is covered by a fine netting. When properly setup, there are no holes that even the smallest of birds or animals can get through.

After consultation with BC Hydro the same net pen location that was utilized during the 2008/2009 project will again be used in the spring of 2009 for the 2009/2010 project. With help from FVTH staff, the net pen segments are transported from the FVTH in Abbotsford to the Hayward Lake recreation site. Assembly and disassembly and mooring of the net are completed by BCCF fisheries technicians with help from FFSBC staff. The dock sections are stored at FVTH and all the required hardware is stored at BCCF to prevent the non-seasonal use by other organizations. In the 2009/2010, additional funds were requested to purchase an additional dock section and associated hardware to provide a stable access point to the net pens from the hydro boat storage dock. Unfortunately, the distributor of the EZ Dock equipment was no longer

around in 2009. The cost of bringing in dock sections and associated hardware from an out of province dealer was not budgeted for in the original proposal and as a result the dock was not purchased and the funds focused on the assessment of returning adults via snorkel survey, DNA kits given to broodstock anglers and communications with anglers.

4.3 Monitoring

Monitoring of this project consists of two components. First, the steelhead smolts will be monitored while in freshwater (in the net pens) to ensure that predators such as herons and otters are not able to access the fish. Fish placed into the pens in late March or early April will be fed twice a day and observations made and recorded at this time. Periodic fish sampling will be performed at various time intervals to monitor the health and weight gain of the fish and to determine the timing for release, with the optimal weight range for release at 90-100 grams.

The second step of monitoring is the initiation of an angler's creel survey in the next few years along with snorkel surveys to collect data on returning adult steelhead numbers. Broodstock anglers have been given DNA sampling kits to use when capturing adipose and maxillary clipped fish. Although uncommon in steelhead, the return of one ocean fish (jacks), have been known to occur in hatchery raised populations. To possibly intercept these early returning fish DNA sampling kits were handed out to broodstock anglers that religiously fish the Stave River each winter. The kits included all the utensils and equipment and written instructions needed to taken proper fish measurements and scale and DNA samples (Figure 2).

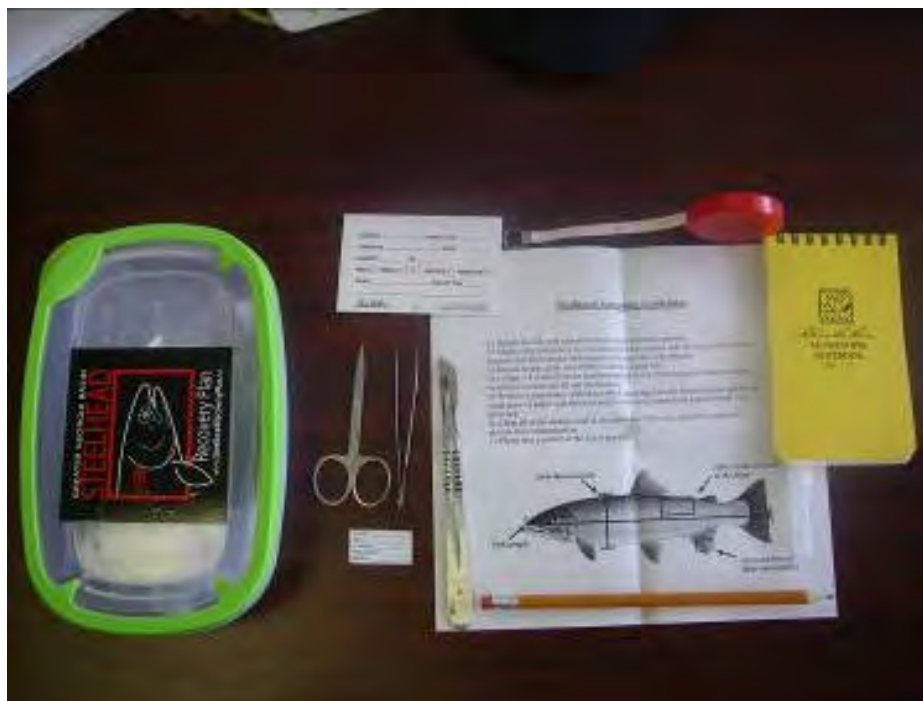


Figure 2: DNA sampling kit handed out to Stave River brood stock anglers to record evidence of returning net pen fish.

Anglers were also asked to get photo documentation of the captured fish to show the differentially marked maxillary clips (Figure 3).



Figure 3: Picture of a steelhead smolt highlighting the general location of the adipose and maxillary clips given to Stave River net pen smolts.

The secondary mark will enable researchers to differentiate between the net pen fish and regularly stock steelhead. In order to evaluate the success of this type of project a data set of snorkel survey counts and angler creel information should be collected for a 4-5 year period.

Snorkel surveys will be performed in the lower Stave River during peak steelhead escapement to identify returning net pen fish.

5. Results

On April 7, 2009, 4278 juvenile steelhead averaging 49 grams were transported to the Hayward Lake net pens. Twice per day, the fish were fed 1.5 mm feed prills and the net pen was routinely inspected for holes from predators and vandalism. Notes were recorded on the feed rate and any observations such as mortalities. Other than the odd mortality being recorded (and removed from within the net pen, a sampling count on May 15th identified an additional 120 fish mortalities. Closer inspection of the fish revealed lesions present in nearly all of them. No holes in the net, loss to predation or vandalism was observed during the project.

Fish sampling in late-May showed the fish were nearing the 100 g target for re-location to the lower river. On May 29, 2009, 2084 fish, averaging 96 g, were removed from the pen by FFSBC staff and transported to the lower Stave River and released. Both FFSBC and BCCF staff were present at the time of the release and did not observe any transport-related mortalities.

BCCF staff performed a snorkel survey on April 15th, 2010 after an angler reported catching and releasing an adipose and maxillary clipped fish on April 12th. Three experienced swimmers surveyed from Ruskin Dam downstream for more than a kilometre. No steelhead were positively identified although two large shadows were observed at the bottom of a large pool.

6. Discussion

The reason for the loss of a significant numbers of steelhead due to mortality while imprinting in the net pens cannot be readily explained. Through discussions with FFSBC staff, the cold water experienced at Hayward Lake may have stressed the fish too much and resulted in their reduced ability to combat viruses and/or parasites normally found in aquatic environments.

Although no steelhead adults were observed through snorkel surveying, the lower Stave River does not lend itself to effective snorkel surveying. There is very little steelhead habitat complexity, below dam pool there is very little wood, boulders and pools, just featureless glides. There is some gravel but largely covered in gravel. Water visibility was slightly coloured (estimated at 3 meters) potentially due to a small amount of precipitation prior to and during the survey. The decent water closer to the dam was too deep to see the bottom. Future snorkel surveys will require refined timing to provide the best visibility (low precipitation) and timing of the peak of the run (through increased angler communications). In addition, communication with BC Hydro to reduce water released from Ruskin Dam may also be beneficial to aid in visibility in the deeper pools.

In the fall of 2010 the BCCF will be submitting a request for funding to BCRP and for the continuation of this project. With the net pen and infrastructure already purchased in the first funding cycle, the funds needed to continue this project will be reduced. However, thisw funding surplus will be partially mitigated by the cost to perform the monitoring component to assess the projects effectiveness through snorkel surveys, creel surveys and communications with anglers. BCCF would also like to continue working with BC Hydro and FFSBC to find reliable a community group within the Maple Ridge/Mission area to take over the caretaking and possibly the implementation of the project.

7. Recommendations

BCCF recommends continued monitoring in the spring of 2011 to capture the majority (peak run) of the fish from the first year of the project (3 ocean fish) and early returns (2 ocean fish) for the second year of the project.

Communications with BC Hydro to coordinate a lowering of water release would be beneficial during snorkel surveys to increase visibility, especially in the deeper pools, to improve chances of enumerating and identifying steelhead adults.

BCCF recommends that the BC Hydro continue to aid in the implementation of this project and perhaps work with FFSBC to create a community based project that is run annually at Hayward Lake. This type of project can highlight the work that BC Hydro is doing in the watershed to aid in the restoration and creation of a once important fishery. Mentoring on the placement and construction of the existing pen can be completed by the BCCF and easily taught to BC Hydro staff and volunteers. It's also recommended that the FFSBC work with BCCF to develop and implement a monitoring program to add validity to the hypothesis and ensure that the fish are not missed when they return in two to three years.

8. Acknowledgements

The BC Conservation Foundation would like to acknowledge BC Hydro’s Bridge Coastal Fish and Wildlife Restoration Program for funding the second year of this important research and enhancement project. Also, Jordan Uittenbogaard is recognized for his dedication to feeding the fish twice a day throughout the project. Staff at the Freshwater Fisheries Society of BC were instrumental in transporting the dock sections to and from the site and especially with the care and handling of the fish while stocking the pens and releasing the fish to the lower river. In addition, the Fraser Valley Trout Hatchery is to be recognized for allowing us to store the dock sections at their facility in Abbotsford for 10 months out of the year.

Finally, the BC Conservation Foundation would like acknowledge the following project supports for their in-kind and technical support or the duration of the project:

- BC Hydro
- Freshwater Fisheries Society of BC
- BC Ministry of Environment
- Kwantlen First Nation

9. References

Lill, A.F. 2002. Greater Georgia Basin Steelhead Recovery Action Plan. Prepared for the Pacific Salmon Foundation. AF Lill and Associates Ltd. North Vancouver, BC. 107 p.

BC Hydro. 2000. Bridge-Coastal Fish and Wildlife Restoration Program: Watershed Plans. Vol. 2, Chapter 7: Stave River Watershed, 25p. Website: http://www.bchydro.com/bcrp/about/docs/ch07_final.pdf

Appendix I – Financial Statement

	BUDGET		ACTUAL	
	BCRP	Other	BCRP	Other
INCOME				
Total Income by Source	7,000	6,800	7,000	6,800
Grand Total Income (BCRP + other)				
EXPENSES				
<i>Project Personnel</i>				
Wages	3,105	6,800	5,214.53	6,800
Consultant Fees (List others as required)				
<i>Materials & Equipment</i>				
Equipment Rental				
Materials Purchased	2,957.37		43.15	
Travel Expenses	101.25		102.58	
Permits (List others as required)				
Volunteer stipend			1,000	
Fuel	100.02			
Safety	100		3.38	
GST				
Administration				
Office Supplies				
Photocopies & printing				
Postage (List others as required)				
Administration (total)	636.36		636.36	
Total Expenses	7,000	6,800	7,000	6,800
Grand Total Expenses (BCRP + other)		13,800		
BALANCE				
(Grand Total Income – Grand Total Expenses)	The budget balance should equal \$0		The actual balance might not equal \$0*	
	0		13,800	

Appendix II – Performance Measures

Performance Measures – Target Outcomes												
Project Type	Primary Habitat Benefit Targeted of Project (m2)	Primary Target Species	Habitat (m2)									
			Estuarine	In-Stream Habitat – Mainstream	In-stream Habitat – Tributary	Riparian	Reservoir Shoreline Complexes	Riverine	Lowland Deciduous	Lowland Coniferous	Upland	Wetland
Impact Mitigation												
Fish passage technologies	Area of habitat made available to target species	steelhead					400m ²					
Drawdown zone revegetation/stabilization	Area turned into productive habitat											
Wildlife migration improvement	Area of habitat made available to target species											
Prevention of drowning of nests, nestlings	Area of wetland habitat created outside expected flood level (1:10 year)											
Habitat Conservation												
Habitat conserved – general	Functional habitat conserved/replaced through acquisition and mgmt											
	Functional habitat conserved by other measures (e.g. riprapping)											
Designated rare/special habitat	Rare/special habitat protected											
Maintain or Restore Habitat forming process												
Artificial gravel recruitment	Area of stream habitat improved by gravel plmt.											
Artificial wood debris recruitment	Area of stream habitat improved by LWD plmt											
Small-scale complexing in existing habitats	Area increase in functional habitat through complexing											
Prescribed burns or other upland habitat enhancement for wildlife	Functional area of habitat improved											
Habitat Development												
New Habitat created	Functional area created											

Appendix III – BCRP Recognition



On-site signage was posted in several high visibility locations to inform the public of the project and the funders during the time the net pens were in place. On February 3, 2010.



Presentations to angling and stewardship groups are used to highlight our funding partners. For example, a presentation was given to 40 members of the Kingfishers Rod and Gun Club on February 3, 2010.

Appendix IV – Project Photo Documentation



Preparing assembly site for the delivery on the dock section.



Full assembly of the net pen prior to movement to the mooring location.



Net Pen moored and ready for net and fish placement.



An example of the signage placed on the net pen at various viewing locations to make the public aware of the project.



FFSBC staff prior to the placement of the smolts into the net pen.



Example of the fish ready to be placed in the net pen.



FFSBC staff sample counting, checking the average weight of the smolts.



Steelhead smolts ready to be released.



Releasing steelhead smolts into the Stave River below Ruskin Dam.



Steelhead smolts after release acclimatizing after their short truck ride.